

## Evolving Convolutional Filter Using Genetic Algorithm for Image Classification

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**Abstract :** Convolutional neural networks (CNN), as typically applied in deep learning, use layer-wise backpropagation (BP) to construct filters and kernels for feature extraction. Such filters are 2D or 3D groups of weights for constructing feature maps at subsequent layers of the CNN and are shared across the entire input. BP as a gradient descent algorithm has well-known problems of getting stuck at local optima. The use of genetic algorithms (GAs) for evolving weights between layers of standard artificial neural networks (ANNs) is a well-established area of neuroevolution. In particular, the use of crossover techniques when optimizing weights can help to overcome problems of local optima. However, the application of GAs for evolving the weights of filters and kernels in CNNs is not yet an established area of neuroevolution. In this paper, a GA-based filter development algorithm is proposed. The results of the proof-of-concept experiments described in this paper show the proposed GA algorithm can find filter weights through evolutionary techniques rather than BP learning. For some simple classification tasks like geometric shape recognition, the proposed algorithm can achieve 100% accuracy. The results for MNIST classification, while not as good as possible through standard filter learning through BP, show that filter and kernel evolution warrants further investigation as a new subarea of neuroevolution for deep architectures.

**Keywords :** neuroevolution, convolutional neural network, genetic algorithm, filters, kernels

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